Space Weather Technical Forecast

Issued on Monday, 02 September 2024 at 00:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-flares expected, slight chance of X-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate with five M-flares in the past 24hrs, peaking with a long period M5.5 flare at 01/1322UTC from the southeastern limb. There are thirteen sunspot regions on the visible disc. AR3806 in the southeast has seen the emergence of a small weak delta spot within its southern trailing region, but has seen a slight decrease in penumbral extent. AR3807 in the southwest is now the largest region, and has seen some of its intermediate spots continue to be absorbed into its main leading and trailing spots. A new region is emerging from around the southeastern limb, with its initial assessment likely to change as it rotates into a more favourable viewing angle. All other regions are relatively simple and stable, or showing some signs of decay.

No Earth directed CMEs have been observed. A large eruption off the southeastern limb during the UTC afternoon has been analysed as having no Earth directed component.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by ACE at L1, have eased following recent enhancements. Wind speeds were initially around slow-ambient levels, but since 01/0850UTC have generally been slightly elevated, currently varying between 390-430km/s. Density has generally been average to below average, although did briefly become above average with a peak of 11pcc around 01/1500UTC. The Interplanetary Magnetic Field, Bt, eased through the period from moderate to weak levels, ranging between 12 and 1nT. The important north-south component, Bz, was weak throughout, but predominantly negative (southward) directed although it did have periods of being positive (northward), ranging through the whole period between +7 and -7nT. Phi angle was initially positive (away from the Sun), becoming variable for a time from 01/0900UTC, and then becoming negative (towards the Sun) from around 01/1420UTC. Geomagnetic activity was Quiet to Active (Kp2-4).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 has seen a recent rise in response to the eruption and M5.5 flare mentioned above. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The 24-hour fluence was below the Active threshold, with 4.61e6 integrated pfu observed at 02/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with a slight chance of isolated X-flares. The main flare risk is currently from AR3806 and AR3807, as well as a new region rotating around the southeastern limb.

Solar Wind /Geomagnetic Activity: There are no Earth-directed CMEs currently expected. The recent enhancement has now eased, although winds remain slightly elevated. The next forecast enhancement is expected on Day 1 (02 Sep), from a narrow negative polarity equatorial coronal hole. Any significant enhancement is unlikely, however.

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Mainly Quiet to Unsettled (Kp2-3) activity is expected on Day 1 (02 Sep), with a chance of Active (Kp4) intervals and only a very slight chance of G1/Minor Storm intervals (Kp5) should we see any prolonged fast wind influence. This risk decreasing from Day 2 (03 Sep), with generally Quiet (Kp1-2) activity expected thereafter.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain mostly at background levels, with a chance of reaching the S1/Minor Radiation Storm level on Day 1 (02 Sep) due to the recent eruption on the southeastern limb. High energy electron flux is expected to remain at background levels, perhaps reaching moderate at times during diurnal maximum. The associated 24-hour fluence is expected to persist below Active.

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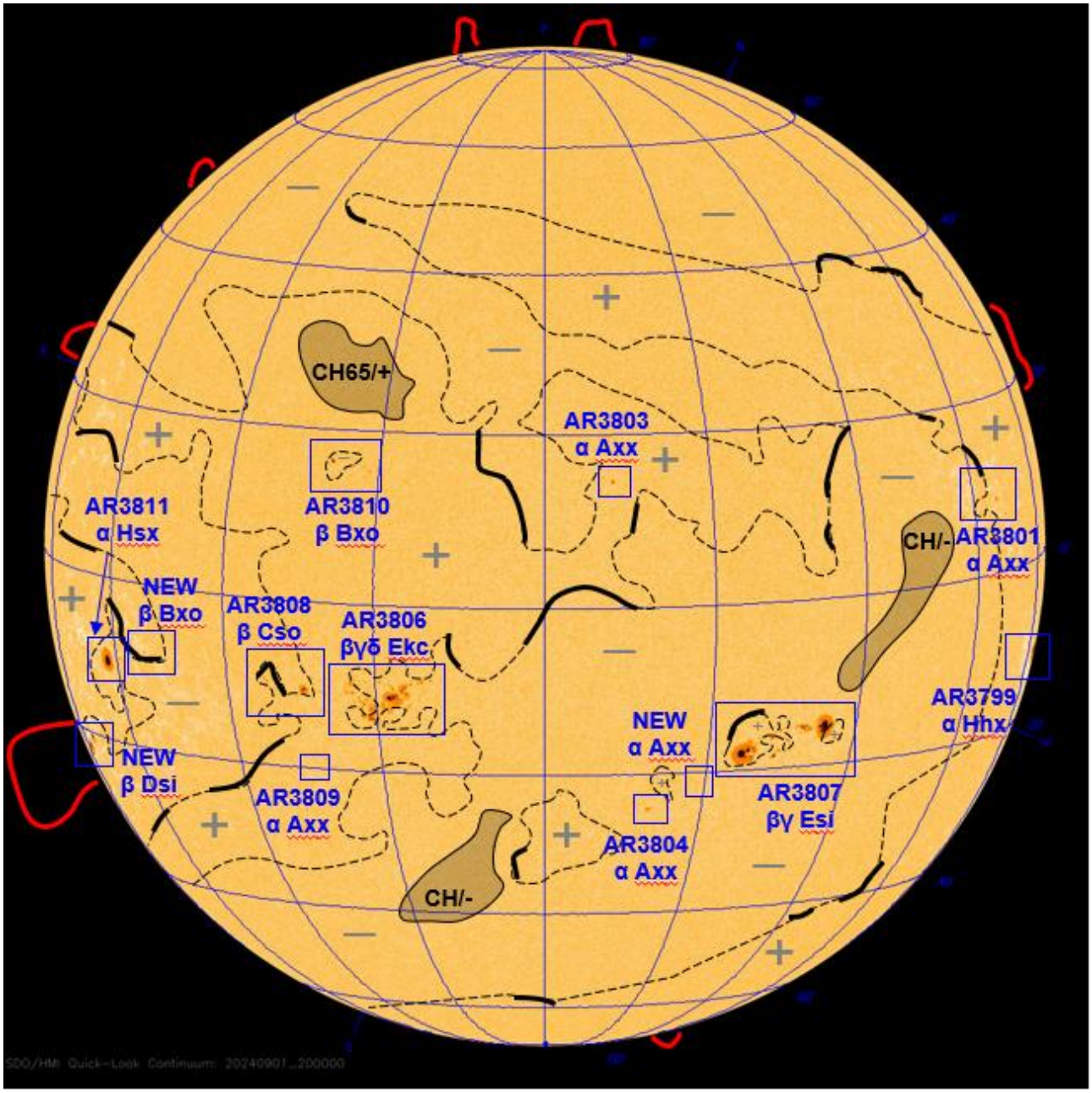
Figure 1. Solar Analysis Valid 01/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs in the forecast. A filament eruption from 30/2330UTC is expected to miss behind Earth's orbit, but the analysis is low confidence due to poor available imagery, and so a glancing blow cannot be ruled out, perhaps on Day 2 (03 Sep). A large eruption off the southeastern limb through the UTC afternoon of 01 Sep has been analysed, with no Earth-directed component expected.

Recent enhancement due to a weak fast wind and/or a weak transient has now eased, although solar winds have remained slightly elevated. A narrow negative polarity coronal hole straddling the equator in the western hemisphere may connect to Earth on Day 1 (02 Sep). Any notable fast wind from this region is low confidence however, due to its small size, lack of persistence and unfavoured polarity for the time of year. MOSWOC Enlil is thought to be overestimating the enhancement, suggesting a strong and broad coronal hole fast wind connection that is not expected.

Mainly Quiet to Unsettled (Kp2-3) activity is expected on Day 1 (02 Sep), with a chance of Active (Kp4) intervals and only a very slight chance of G1/Minor Storm intervals (Kp5) should we see any prolonged fast wind influence. This risk decreasing from Day 2 (03 Sep), with generally Quiet (Kp1-2) activity expected thereafter.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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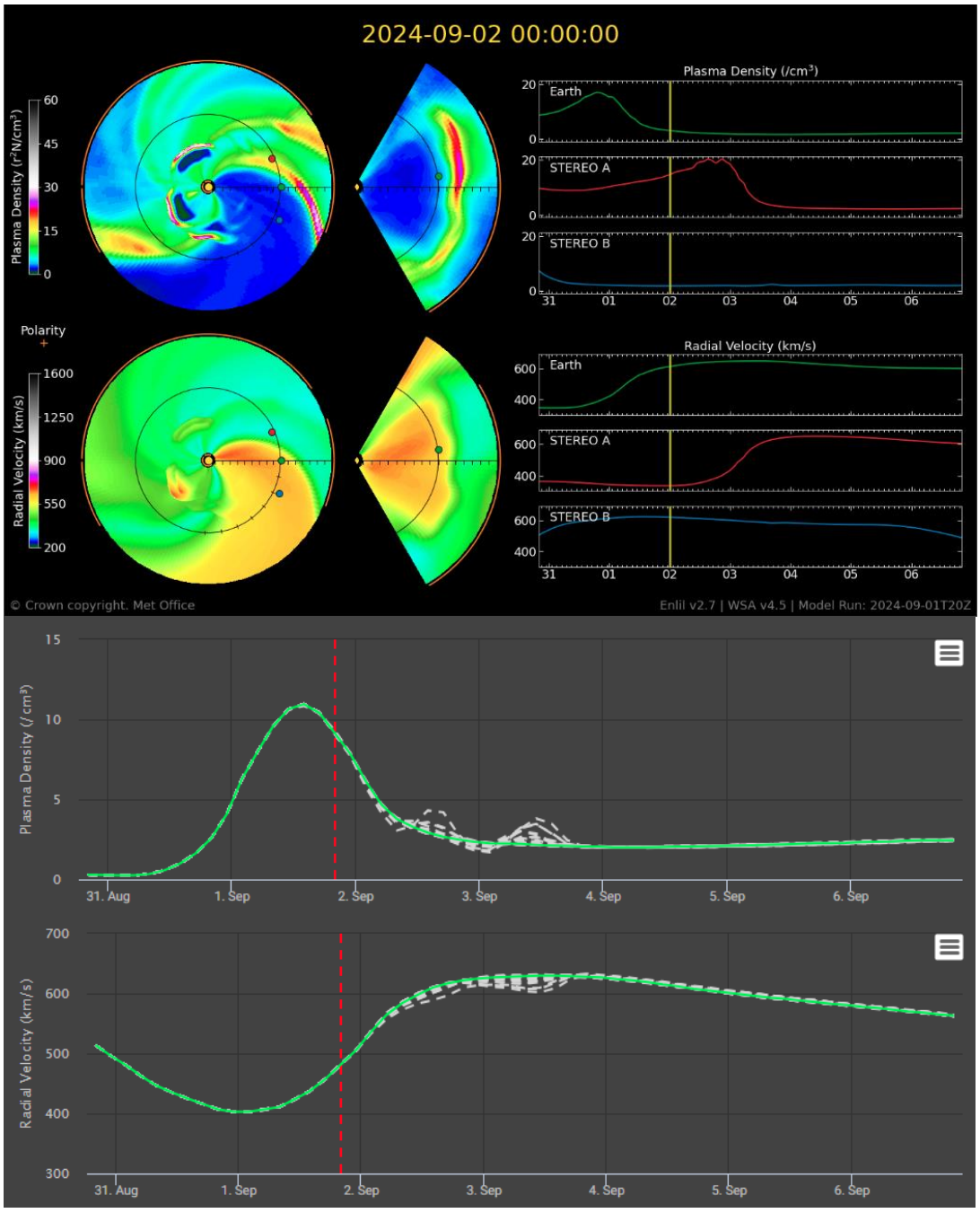
Figure 2: MOSWOC Enlil and Ensemble models, both overplaying magnitude and extent of anticipated coronal hole high speed stream.



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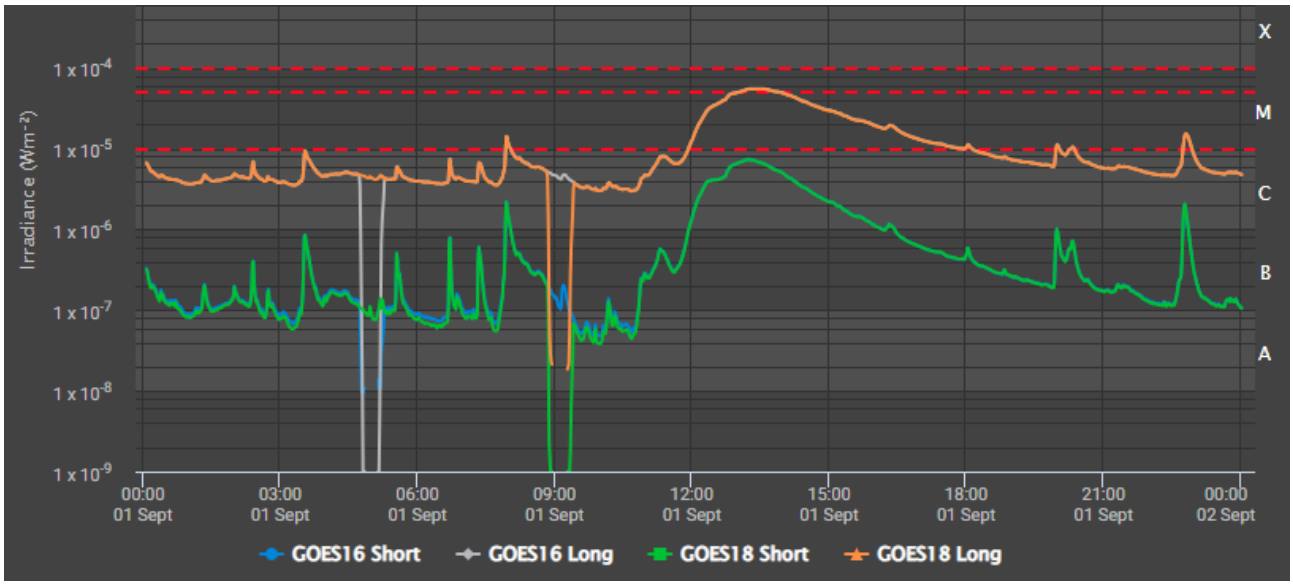
Radio Blackouts - X-Ray Flares:

There are thirteen sunspot regions on the visible disc. AR3806 in the southeast has seen the emergence of a small weak delta spot within its southern trailing region, but has seen a slight decrease in penumbral extent. AR3807 in the southwest is now the largest region, and has seen some of its intermediate spots continue to be absorbed into its main leading and trailing spots. A new region is emerging from around the southeastern limb, with its initial assessment likely to change as it rotates into a more favourable viewing angle. Magnetic looping evident in aia-171 imagery, as well as the largest flare of the period from close to this location, suggests this may be a region to keep an eye on. All other regions are relatively simple and stable, or showing some signs of decay.

Further Moderate activity is expected, with a slight chance of rising to High. Although there are two regions rotating off the disc in the coming day, the emerging regions on the east limb will balance any losses - or even raise the probabilities a little. However, we need to wait for a clearer view before this can be properly assessed, and as such a nominal flare risk is maintained.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	75
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: GOES-16 & -18 X-ray flux.



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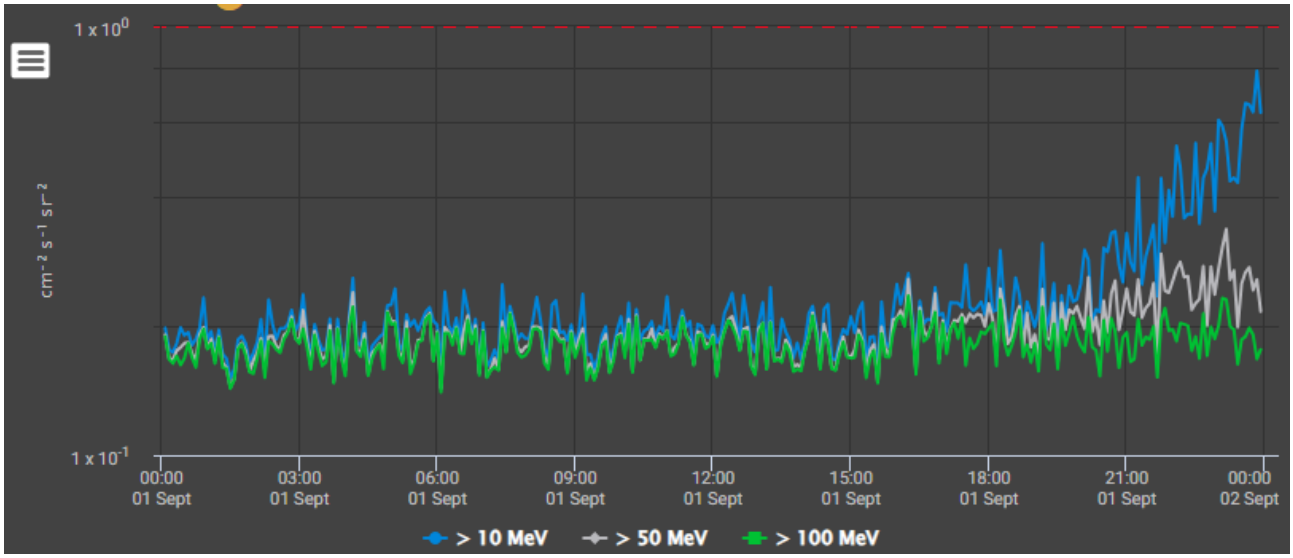
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, is experiencing a rise in response to the large eruption and M55 flare off the southeastern limb during the UTC afternoon of 01 Sep. An increased risk of reaching S1/Minor Radiation Storm levels is reflected in the Day 1 values.

Beyond this, proton flux is likely to fall back to background levels with a slight chance of rising in response to any notable flares, AR3806 and AR3607 the most likely candidates for this. The risk rises a little after Day 2 (03 Sep) as AR3806 crosses into the western hemisphere, which is the better connected region of the Sun to give proton flux rises at GEO.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 Proton flux.



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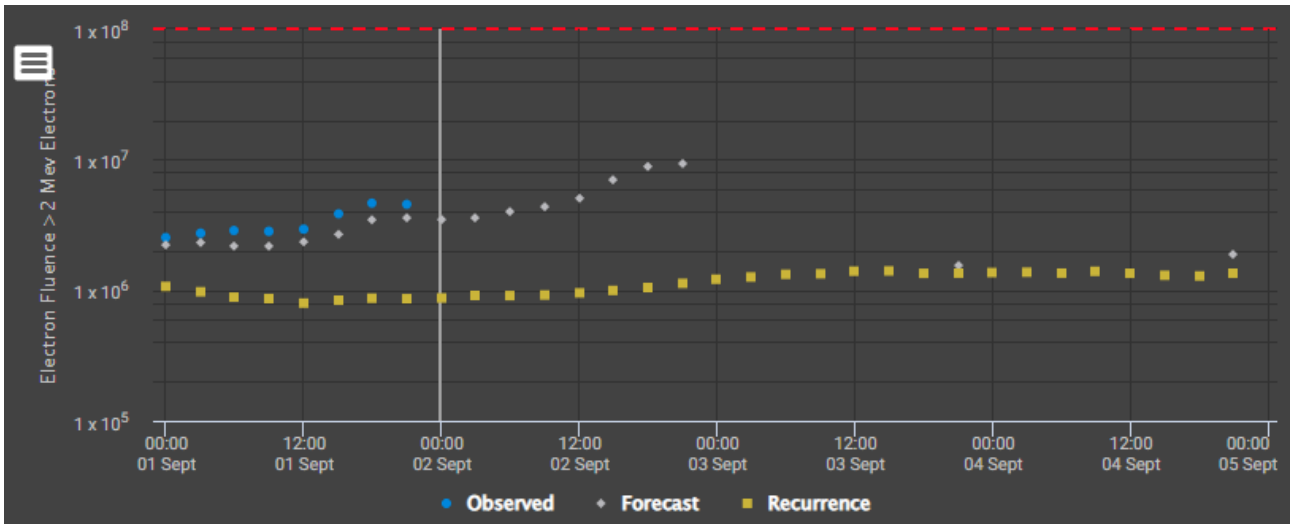
High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 is mostly at background levels, with moderate diurnal rises. Recent enhancements have given some geomagnetic activity but little in the way of wind speed increases. Whilst there is the potential for increased electron counts at lower orbits, this is considered unlikely to be significant. Periods of moderate flux should continue during diurnal maxima over the coming days.

Despite the potential for any increased flux, the associated 24 hour Fluence is expected to remain below the Active (1e8 integrated pfu) threshold throughout, although a slight rising trend is likely. MOSWOC REFM is providing good guidance for staying below this level, but likely underestimating its rising trend over the coming days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM.



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